Insights

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Models: What are they and why use them in forest management?

By Lisa J. Buse

Do you hesitate to use models to make resource management decisions? Do you question the usefulness of models? You are not alone! Let's look at what models are and what they can be used for and hopefully increase your interest and confidence in the usefulness of models for forest management.

What is a model?

Models can be physical, verbal, or mathematical; they can be exact replicas or representations. For example, a clay figure and a globe are both physical models that are replicas of the real thing; a description is a verbal model based on someone's interpretation; and an equation is a mathematical model.

You probably use models every day. You look at the sky and forecast what the weather will be; you think about how your day will unfold on your way to work. Both of those processes are based on a model, albeit an informal, undocumented one.

Here's how a few OFRI scientists explain what a model is:

"Models are essentially just a reflection or representation of reality," says Voyteck Zakrzewski.

"Models formalize how an object or group of interacting objects behave under certain conditions," adds Michael Ter-Mikaelian. "In forest models, the object is usually represented by measurements, or data, that describe some part of the forest or the interactions among various parts."

Photo by Bill Cole

OFRI's Voyteck Zakrzewski demonstrates the TCM/PAM system, modelling software that can be used to estimate tree or stand timber volume in the field based on local yield information.

"Models are a way of putting some rigour (in the form of logic) around a hypothesis," says Ajith Perera. "For example, consider the statement: *Trees grow fast on good sites.* Intuitively you understand that this is true, but can you define *fast* or *good*? Mathematically you can say the same thing using the equation $\Delta g = f(s)$, where Δg is tree growth rate, but you have to clearly define s, site quality, and f, the relationship of site quality to tree growth, based on your experience and available scientific information, or data."

In other words, a model is a formalized explanation of an object or process. Forest models are

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usually quantitative, that is, they measure something, and computer based, so they can handle data more efficiently.

What constitutes a good model?

Like any other tool, some models are better than others. A good model is based on sound scientific data, the assumptions used in its development are clearly stated (both what was included and what was excluded), and it provides realistic and repeatable results. It should be clear what the model can be used for and what its limitations are. A really good model allows new information and knowledge to be incorporated as they become available to improve the results.

Why use models?

"Models can be used to verify what we know about a system and how it works and to identify gaps in our knowledge," says Ter-Mikaelian. "Then, as researchers, we try to fill those gaps to improve our knowledge base."

Models can also be used to synthesize complex knowledge, for example, by using them to build a decision support system. And they can be used to explore or compare scenarios. For example, a model could simulate the growth of a forest stand incorporating our knowledge of the effects of climate change or simulate the effects of forest disturbance on wood production or wildlife habitat.

In resource management, models can be especially useful for exploring the potential outcomes of decisions before implementing them on the ground. Scenarios and their potential results can be compared and the most acceptable option chosen.

In summary, models are used to help us to understand how things work, make complex decisions, and explore potential outcomes of decisions. The validity of the results depends on the quality of available data, the assumptions used to develop the model, and knowledge of the various interacting factors involved in the processes being modelled or predicted. As we attempt to integrate more complex layers of biological information, models will likely play an even more important role in our resource management decisionmaking.

Examples of models developed at OFRI

By Lisa J. Buse

For those who are more familiar with models, a brief overview of some of OFRI's modelling efforts is provided below; for technical details, contact the scientist named, or request the cited publication. These are only some examples of the many models being developed and used in forest management in Ontario.

Tree-level models: Tree-level models help managers understand more about how trees develop in response to their environment. Two examples: Individual tree biomass models were developed for Ontario's ice storm-related research (for more information, see staff profile about Michael Ter-Mikaelian on Page 3 or request Forestry Chronicle 2000, 77(4): 643-649). And a taper model was developed by Voyteck Zakrzewski to predict tree shape, allowing more accurate estimates of how much wood trees contain. This model was recently used by OMNR staff addressing the softwood lumber dispute.

Growth and yield models: Growth and yield models, which are often used to forecast wood supply and thus determine sustainable harvest levels, predict future changes in forest stands based on knowledge about what is there now. In the past, these models consisted of tables or graphs based on measurements taken at various stages of stand development to determine how much wood a given tree species produces based on its age and the site type. The same tables were used for the entire province.

Advances in computing technology have allowed researchers to develop models and tools that provide similar but more locally applicable information. For example, the TCM/PAM system, timber cruising software developed by Zakrzewski, can be used to estimate tree or stand timber volume in the field based on local yield information.

Competition models: Models can also be used to understand interactions among trees. Ter-Mikaelian and his colleagues have developed a competition model that explains which factors are most important when plants compete with trees (for details, request Canadian Journal of Forest Research 2000, 30(5): 790-800). Such models help forest managers decide when and how often to control competing vegetation to ensure crop trees survive and grow.

Landscape dynamics models: Over the last decade, resource managers have started to think more about the whole landscape and not just about individual forest stands in a management unit. Landscape-level models are generally based on larger areas and longer timeframes and thus provide information at broader scales. For example, BFOLDS, which stands for Boreal Forest Landscape Dynamics Simulator, is a model that predicts the medium-term (several centuries) forest fire regime over millions of hectares for boreal forests in Canada. Developed by Ajith Perera and his colleagues, it "integrates the scientific knowledge of forest fire and forest vegetation changes in time and space." The model can be used to establish natural disturbance regime baselines or to determine which areas are more fire-prone than others and thus should not be managed intensively or expected to support old growth forest (for details, request OFRI Forest Research Report No. 152, available fall 2003).

Carbon-budget models: At the provincial scale, researchers are using models to estimate changes in carbon budgets to meet provincial commitments to national efforts such as the Kyoto Protocol. In Ontario, Changhui Peng and his colleagues have applied a carbon budget model that estimates the amount of carbon stored in soil and plants and released into the atmosphere (for details, request OFRI Forest Research Report No. 158). In addition, they've developed a new hybrid forest growth and carbon dynamics model called TRIPLEX, which can be used to predict forest growth and yield and to quantify carbon budgets given the potential effects of short- and longer-term climate change (for details, request Ecological Modelling 2002, 153: 109-130).

You can reach Voyteck Zakrzewski at ext. 437, Michael Ter-Mikaelian at ext. 432, and Ajith Perera at ext. 426 (e-mail addresses are firstname.lastname@mnr.gov.on.ca). Changhui Peng is on sabbatical leave in South Dakota until August; he can be reached at 605-394-1996, changhui.peng@sdsmt.edu. To request a publication, dial the OFRI publication request line at ext. 271, or e-mail information.ofri@mnr.gov.on.ca.

OFRI STAFF

Photo by Trudy Vaittinen

Michael Ter-Mikaelian

By Abigail M. Obenchain

How many research scientists you know have spent some of their career preparing chicken carcasses to go to market, laying asphalt, or driving a bulldozer without a license or any training?

Meet Michael Ter-Mikaelian, who during his career has not only established himself as a world-class forest modeller but also worked as a farm laborer.

"One of the unwritten job duties for a Soviet research scientist was to participate in mandatory work at collective farms," he says. "Any kind of institution, whether a factory or a research institute, had to provide a certain amount of manpower. So every year, I packed up and went to work on a farm for a few weeks."

During his career as a Soviet modelling scientist, Michael accomplished much more than farmwork. He received a PhD in ecological modelling from the Institute of Global Climate and Ecology in Moscow; his doctoral work focused on a model of long-term landscape fire dynamics under various climate change scenarios.

Other projects from his Soviet days include a boreal forest succession model, which focused on how Siberian pine competes with white birch, and a model of individual tree *ontogenesis* (how an individual plant grows and develops from fertilization to the end of its life cycle).

In 1987, he was accepted into a prestigious young scientists summer program at the International Institute for Applied Systems Analysis, a multidisciplinary, non-governmental research organization in Vienna, Austria, where he had the rare honour of being chosen to return for a second summer on scholarship.

In 1992, Michael came to Canada to lend his modelling expertise to OMNR's Vegetation Management Alternatives Program. Over the past decade, he has worked on a range of projects, including:

- Compiling a database of published biomass equations for 65 North American tree species. These equations can be used to conduct more accurate forest inventories and to model tree growth, carbon storage, and fire danger (through estimating the amount of fuel [wood] in the forest).

  Michael says, "There's a lot of variability in biomass equations, so you can get a more accurate picture by taking the average of several equations." Several biomass equations that he developed were used in Ontario's ice damage research to estimate pre-damage tree biomass.

- Developing a light competition model, which predicts how young trees are affected by varying light conditions. "A light model is a particularly important component of a growth model," he says, "because in northern Ontario, light is the most important resource affecting the growth of seedlings."

- Developing a growth model for young jack pine and black spruce, which predicts growth based on the presence of competitive plants in varying densities.

- Helping to develop ON-FIRE, a *spatially explicit* (based on geographic information) model for simulating Ontario's forest fire patterns at the landscape scale.

- Evaluating the accuracy of taper equations, which predict tree shape and allow more accurate estimates of how much wood forests contain.

- Co-leading a project to adapt the Canadian carbon budget model to Ontario conditions using local data, so the effects of stand-level activities on carbon storage and release can be determined.

Michael is highly regarded by his colleagues at OFRI. "His integrity as a scientist is impeccable," says OFRI's Steve Colombo, who is working with him on the carbon budget project. "He is recognized for his accomplishments by leading forest modellers around the world but you would never know it based on his unpresuming personality."

He adds, "Mike also holds in his head a vast storehouse of Russian humour, which he shamelessly inflicts on others."

When asked what he likes to do off the job, Michael replies, "Soccer, soccer, and soccer." He is on the executive committee of the Sault Youth Soccer League and is general manager of the travelling teams division. He also coaches and referees and is on the executive committee of the Ontario North Region Soccer League. In between soccer commitments, he likes to - you guessed it - watch soccer on television.

You can reach Michael Ter-Mikaelian at ext. 432, michael.termikaelian@mnr.gov.on.ca. For information on publications related to his work, e-mail information.ofri@mnr.gov.on.ca.

Survey reveals that "personal" technology transfer tools top clients' wishlists

By Abigail M. Obenchain

Over the past decade or so, several new methods of delivering information have been developed: e-mail, websites, software. Are forest research clients taking advantage of these new tools? Would they like to see more use of them in the future? We decided to find out, so in fall 2001, working with OMNR's Centre for Northern Forest Ecosystem Research in Thunder Bay, we surveyed our Ontario clients about technology transfer methods.

What we learned is that there is no substitute for the human touch. Whether we were asking about clients' previous 3 years of transfer experiences, their most positive experience, or future transfer preferences, respondents indicated that they have benefited most from and prefer presentations, field tours, and one-on-one contact. As an OMNR regional science coordinator commented during survey development, ".... Tech transfer should be as 'personal' as possible, i.e., small workshops or 'targetted' field trips. Many people are overwhelmed with information (e-mails, reports, etc.), and if tech transfer consists only of publishing in a journal (or even in an internal publication like a guideline), it does run the risk of being overlooked...."

Client involvement in a project was mentioned by several respondents as an important factor in positive transfer experiences. While client involvement is not really a transfer tool, when clients are involved, transfer is clearly more successful (research is more likely to be relevant to clients' needs, clients will have continuous exposure to the project, they are more likely to promote work they helped organize, etc.).

OFRI general manager David DeYoe says, "Successful tech transfer is all about building relationships and trust and engaging the right mix of people early in the process (preferably at the outset) of designing the research and extension plan and keeping those people engaged throughout the process."

Photo by Bob Sinclair

OFRI research geneticist Pengxin Lu presents results of a white pine genecology study during a field tour. Respondents to our technology transfer survey ranked field tours at the top of the list of tech transfer tools we should focus on in the future.

What about publications?

Despite the preference for personal transfer tools, technical publications, such as research reports and field guides, are not to be dismissed. They placed ahead of some of the personal contact tools in the category of usefulness over the previous 3 years, possibly because these tools have a long shelf life and are likely to be used repeatedly as part of a continuous transfer process. What's more, they are repositories for technical details that may not be included in a presentation or field tour.

While respondents appear to find paper newsletters, web/e-mail-based technologies, and software the least useful as *transfer* tools, they also should not be disregarded. The first 2 types of tools are suited less to direct transfer and more to communicating the availability of more typical transfer tools like workshops and reports. Without them, information on workshops and reports would be hard to find. Software is a fairly rare tool that many respondents may not have a lot of experience with, so it is difficult to draw conclusions about future use. Its major drawback is a limited shelf life.

Past use of new technologies appears to be minimal. When respondents were asked about their past transfer experiences, they ranked paper newsletters above websites and e-mail tools. And when we asked respondents how often they had accessed information about OFRI and CNFER on the web during the previous year (OMNR staff were asked about accessing OMNR Intranet sites as well), more than two thirds said they either didn't know about or had never accessed OFRI and CNFER's sites. Only a small percentage said they use them regularly.

However, when asked about what tools they would like us to use *in the future*, respondents ranked web- and e-mail-based tools higher than paper newsletters. Paper newsletters are unlikely to become obsolete, because not everyone has access to the Internet and because many people are more likely to

read something that lands on their desk than something they have to go find on a website. Our first step to address evolving attitudes toward electronic tools will be to develop an e-mailing list of clients who would like to receive regular research updates via e-mail (see insert about our new e-mailing list with this issue).

Why transfer fails

A third of respondents reported that they have never had a positive transfer experience, and lack of time was the top reason cited. When asked during survey development about why transfer fails, one science specialist said, "I have a pile of things to read that just don't get read - it's my guilt pile.... If I could read a hard copy newsletter bi-monthly with snapshots of what is happening and where to go for more information if it is really up my alley - then I could get rid of the guilt pile and still be somewhat informed...." While technology transfer staff cannot add more hours to the day, they can work with research staff to ensure that information is concise, relevant, timely, interesting, practical, and field oriented and encourage those who are in a position to address workload to do so.

Interestingly, respondents were evenly split between those who said they get the right amount of information about forest research advances (48%) and those who said they get too little (47%). Just 4% said they get too much.

The second most common reason for lack of a positive transfer experience was lack of exposure to OMNR transfer efforts. In the future, transfer strategies should reflect that a significant number of resource professionals, particularly those outside OMNR, are not getting any message at all from OMNR research units. Other common problems that were cited include ensuring clients are exposed to results that are relevant to their work (again, ensuring client involvement in the project will help) and providing sufficient technical support/ recommendations.

OFRI plans to develop a transfer action plan to ensure survey results are reflected in future transfer efforts.

To obtain a copy of the full survey report, call the OFRI publication request line at ext. 271 or e-mail abigail.obenchain@mnr.gov.on.ca.

Some survey respondents' comments about technology transfer

- *[The research information that was transferred successfully] was needed and directly linked to the needs of practitioners.... The program functioned as an extension program. Tools were developed with the practitioners in mind. They were simple low-tech solutions to real problems.*
- *Transfer needs to be less of a black box, where information comes out and forest managers do not have good information on how it was developed....*
- *I cannot stress enough the value of one on one discussion with OFRI or CNFER staff.... It is very important to get these people out to the field and to staff in [OMNR's] forest management and industry relations branches.*
- *I have found transfer of new information from OFRI and CNFER to be very poor over the years. The emphasis has been on conferences and research journal publications. What I am looking for is field application of research results, getting the research out to the practitioners. Both organizations need to focus more on tech transfer in practical hands on approach.*
- *The staff at OFRI were very helpful and provided us with all the information that was needed. They were always there when problems or questions arose.*
- *When transferring any new information, present it in a manner the audience can understand and relate to. Too many presentations get bogged down in graphs, figures, etc. Just report the trends or summarize the information highlights.*
- *Timeliness of reporting is critical. Interim reporting or best bets are valuable. Don't wait for journal paper....*
- *Most staff either doesn't have the time or don't make the time to visit website. Workshops and field tours are by far the best way to get the message across.*
- *The web site would be very useful because it allows the user to search and select. It also provides an overview of what is happening and who is involved....*

About the survey respondents ...

The OFRI/CNFER technology transfer survey was mailed to 353 recipients across Ontario last fall; 101 of them completed the survey (29%).

These respondents comprised:

40%	**forest managers/ foresters**
17%	**resource technicians**
14%	**biologists**
12%	**forest policymakers**
6%	**forest planners**
6%	**researchers/science specialists**
4%	**educators**
2%	**other**

Their employers:

55%	**OMNR**
28%	**forest industry**
8%	**academic institutions**
3%	**First Nations**
3%	**"other"**
2%	**were consultants**
1%	**federal government**

Why are aspen dying in northeast Ontario?

By Abigail M. Obenchain

An unusually long period of forest tent caterpillar defoliation is probably the primary cause of aspen decline in northeastern Ontario, concludes OFRI scientist Jean-Noël Candau, who's been analyzing the decline and has published his results in an OFRI research report.

"We looked at the pattern of forest tent caterpillar defoliation since 1948," he says, "and normally there are long breaks of 10-20 years between forest tent caterpillar outbreaks, which each last just a few years. However, in northeastern Ontario, aspen have been subjected to a nearly continuous outbreak since 1989, and the stress of repeated defoliation may be taking its toll."

Using statistical means, he compared the decline areas with nearby healthy areas and determined that the most significant predictor of mortality was defoliation frequency between 1989 and 1998. Other significant factors include time since last defoliation (more recent defoliation increases the likelihood of mortality), percent of deciduous cover (mortality is greater in areas with more deciduous trees), distance to transportation corridors (decline areas tend to be along roadways), and tree height (taller trees are affected more, possibly due to their age). Moisture stress brought on by a 1998 drought, clay soil, and stand age (mature/ overmature trees are predisposed to decline) probably contributed as well.

Forest health staff with OMNR's Forest Health and Silviculture Section and the Canadian Forest Service first became concerned about defoliation levels in 1999. In 2000, they determined that trees were not just being defoliated but also dying (forest tent caterpillar defoliates trees in early summer, and aerial surveys later in the year showed leaves were not growing back). Forest tent caterpillar outbreaks usually don't kill trees, so Candau was asked to investigate.

"The decline is continuing today," he reports. "In the last 3 years, the affected area has increased by about 150,000 ha per year, for a total of nearly 450,000 ha."

He explains that forest managers are concerned because these large areas of aspen will likely succeed to balsam fir and then aspen again, rather than more highly valued conifer species.

His next step is to refine the computer model that resulted from his analyses so resource managers can use it to predict which aspen stands are most susceptible to future problems.

For more information, contact Jean-Noël Candau at ext. 406, jean-noel.candau@mnr.gov.on.ca. To obtain a copy of his report (Bioclimatic analysis of declining aspen stands in northeastern Ontario, *OFRI Forest Research Report No. 154), call the OFRI request line at ext. 271 or e-mail information.ofri@mnr.gov.on.ca.*

LLT Awards Nearly $500,000 to Stand-Level Adaptive Management (SLAM) Project in Northeastern Ontario

By Abigail M. Obenchain

The Living Legacy Trust (LLT) has awarded $489,200 over 18 months to a collaborative research group, including OFRI, to conduct a stand-level adaptive forest management project known as the SLAM Project in northeastern Ontario.

"We and our partners are very pleased that this project has received LLT funding," says OFRI research scientist Blake MacDonald, who is the science lead for the silvicultural component of SLAM. "Modified harvesting and renewal will be conducted on a large scale near Cochrane and Gogama to advance our knowledge of boreal mixedwood forest ecology and silviculture. This work will be done in an adaptive management framework, which means that we will have a process in place for monitoring and evaluating outcomes of our practices and using the information we gather to continually improve these practices."

He adds that the focus is on boreal mixedwood forests because although this type of forest has been greatly increasing in Ontario, it has been the subject of relatively little research. "Managing for mixedwood forests may increase biological diversity, enhance wildlife habitat, improve pest resistance, and maintain ecological processes," MacDonald says. "But traditional harvesting practices in these forests promote hardwood regeneration at the expense of conifers. We will be working to determine the best ways to adapt our harvesting and renewal practices so that the valuable conifer component is maintained along with the hardwoods."

Based on the Terms and Conditions of the Class Environmental Assessment for Timber Management on Crown Lands in Ontario, OMNR is developing a mixedwood silvicultural guide, with recommended practices. According to MacDonald, results of the SLAM project will be incorporated into future revisions of the guide.

Other OFRI staff involved in this project include mixedwood research forester Jim Rice and soils research scientist Jim McLaughlin. Project partners are the Upper Lakes Environmental Research Network (ULERN), Abitibi-Consolidated, Domtar, Forest Engineering Research Institute of Canada (FERIC), Lake Abitibi Model Forest, Canadian Forest Service, and Sault College.

For more information on the SLAM Project, contact Blake MacDonald (ext. 416, blake.macdonald@mnr.gov.on.ca).

Do Ontario's jack pine plantations have stability problems?

By Abigail M. Obenchain

A research team led by OFRI's Steve Colombo, Tony Zhang of FORINTEK, and Laura Challen of LUSTR Co-operative has begun to investigate instability in Ontario's planted and site-prepared jack pine forests.

According to Colombo, jack pine is under scrutiny because this species is especially susceptible to root deformities and is the second most commonly planted species in Ontario (after black spruce), with more than a billion seedlings planted since 1980. "If we find that the problem is widespread, the economic fallout in terms of lower wood yield and quality in the next 20-30 years could be considerable," he says. "Some of what we've seen in the field certainly has us concerned."

During a recent field tour in northwestern Ontario, OFRI research scientist Colombo and fellow tree stability project team member Shelagh Duckett, a regional forest health and silviculture specialist with OMNR's Forest Health and Silviculture Section, saw quite a few jack pine stands with unstable trees. "The first stand was a 20-year-old Paperpot plantation, and we couldn't find a single straight tree," Colombo says. "Many were leaning at angles of 20 degrees or more, and every tree we pushed on was loose."

Later, Colombo and another project team member, Thom McDonough, a stand establishment specialist with OMNR'S Forest Health and Silviculture Section, toured jack pine stands between Thessalon and Chapleau. In one 18-year-old stand that appeared to have been planted with bareroot seedlings, the trees weren't leaning, but Colombo and McDonough were able to pull them down to the ground with little trouble. "If we can pull them over, you can imagine what might happen in a windstorm or under a load of wet, heavy snow," Colombo says. "But these stands may or may not lean or topple. It will depend on whether they experience some external pressure."

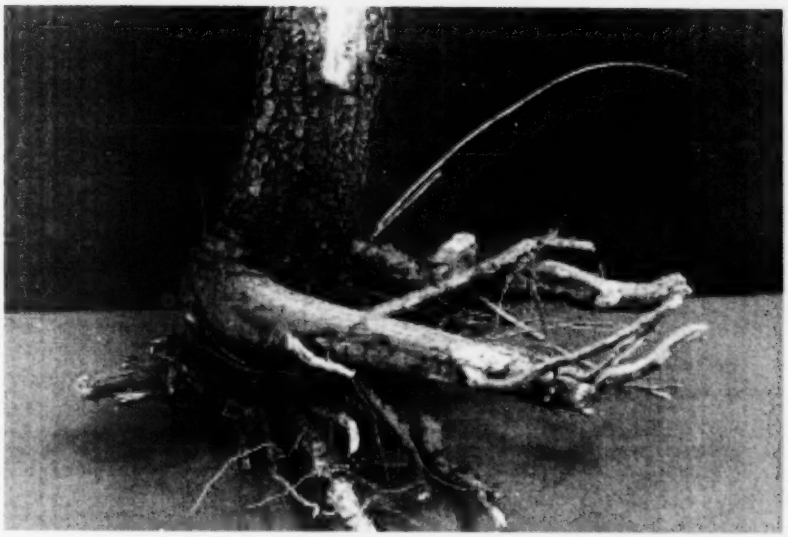

Photo by Bill Cole

OFRI research scientist Steve Colombo easily pulled over this 18-year-old jack pine in a stand south of Chapleau. This tree probably came from a bareroot nursery and was planted with all its roots pointed in one direction, leading to stability problems.

What causes tree instability?

In many cases, container type may be the culprit. Colombo explains that in the late 1970s, the Paperpot seedling container was hailed as a forest regeneration breakthrough in eastern Canada. Replacing the hard plastic "Ontario tube," this container was supposed to degrade quickly after planting so the tree's roots would grow laterally rather than down. Unfortunately, the Paperpot turned out to be far more persistent than expected.

"When you dig up a Paperpot jack pine tree 10 years after planting, you often can still find the paper container intact," Colombo says. "The lateral roots have not grown out as expected, and this has resulted in some unstable trees with poor root form. Bareroot jack pine trees can also have stability problems because the lateral roots may be wrapped or twisted around the tree when it is planted. In jack pine, such roots remain twisted throughout the life of the tree."

What questions do researchers hope to answer?

- *How many stands of jack pine in Ontario are unstable and have deformed trees, how old are they, what condition are they in, and what seedling container and site preparation methods were used for each?*

"We hope to find planting records that tell what type of container was used, but just knowing the stand age is a big help, because we have a pretty good idea of when various container types were favoured," Colombo says. This information, which Colombo hopes will be compiled by fall 2003, will tell researchers the extent of the problem and help them develop a list of criteria for identifying stands that are at risk for stability problems and those that might be too unstable to thin. LUSTR recently hired a new staff person to contact foresters and consult silvicultural records to find stands worthy of further investigation (if you have information that might be helpful, contact Kim Chapman at OFRI (ext. 210, kim.chapman@mnr.gov.on.ca).

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· *At the tree/stand level, what are the potential losses in wood volume/quality and product value due to stem deformities?* Tree-level models will be developed to estimate product recovery and losses in wood volume and product value. Unstable stands that are not yet leaning will be assessed to determine whether they are likely to lean in the future.

· *How will this problem affect wood supply?* "Hopefully, we'll find out that this is not a significant problem. But if many of the millions of jack pine Paperpot trees are affected, the economic impacts could be considerable since instability will likely reduce both yield and quality."

· *How can the lower-quality* compression wood *that results from poor tree form be used by the wood-processing industry?* For example, how can the sawing pattern be changed to minimize the warping effect often caused by compression wood?

· *Which container types, stock production practices, and site preparation methods result in the best root form and minimize stability problems after planting?* Some of the more promising containers under study include Jiffy pellets, StarPots, and Copperblock containers, all of which are designed to promote the growth of lateral branching roots.

"There haven't been many research projects in Ontario that have studied a question from seed to sawmill - through establishing seedlings in the nursery, site preparation, planting, plantation problems, harvesting, and product conversion," Colombo concludes. "This project is an opportunity to put all the puzzle pieces together."

For more information on this project, contact Steve Colombo at OFRI (ext. 409, steve.colombo@mnr.gov.on.ca). Project co-leads: Tony Zhang, FORINTEK, Sainte-Foy, QC, and Laura Challen, LUSTR Co-op, Thunder Bay, ON. Other partners and collaborators: OMNR staff in Kenora, Sault Ste. Marie, South Porcupine, and Thunder Bay; Abitibi Consolidated-Fort William Division, Thunder Bay; Beaver Plastics, Edmonton, AB; Domtar, Espanola, ON; ForestCare Corp., St. Williams, ON; Forestry Research Partnership, Mattawa, ON; Jiffy Products Canada, North Bay, ON; KBM Forestry Consultants, Thunder Bay; Kimberly-Clark Inc., Longlac, ON.

OFRI scientists sink into climate change research

By Abigail M. Obenchain

OFRI scientists Jim McLaughlin and Changhui Peng are joining more than 40 government and university researchers from across the country in the new research network Fluxnet-Canada, the goal of which is to answer important scientific questions related to developing Canada's climate change policy.

McLaughlin explains that Canada's boreal forests are an important focus of climate change work because they occupy a large area of the northern hemisphere and store or *sequester* a huge amount of carbon in the trees and soil. He says that scientists want to verify *how much* carbon these forests hold so Canada can get credit for being a carbon sink to offset fossil fuel emissions.

However, nothing is simple when it comes to climate change: If the boreal climate warms and dries out as expected, soil carbon could start to decay more quickly. If trees cannot offset the potential increase in soil carbon release by increasing their uptake of carbon dioxide, then boreal forests could actually start contributing to climate change. As a result, Fluxnet researchers are also investigating how to adapt forest management practices to prevent a change from sink to source. For example, reducing the numbers of trees killed by insects could help slow forest decay and thus the release of carbon.

For the Ontario soil component of Fluxnet-Canada, McLaughlin and project co-lead Ian Morrison of the Canadian Forest Service will focus on how carbon cycles through soil in a boreal mixedwood forest near Foleyet. This site is one of 10 forest sites and two peatland sites that network researchers will be studying. The Ontario scientists chose a boreal mixedwood site because little research has been done in this type of ecosystem.

Peng's role will be to continue his work in modelling Ontario's carbon budget (how much carbon is stored in Ontario's forests and how it might change depending on climate, forest management, fire, insect outbreaks, etc.), using new data collected by Fluxnet researchers. He explains that modelling is an important part of climate change research because it allows researchers to estimate how much carbon Canada's forests hold now and could hold under various ecological scenarios.

Other OMNR staff involved in Fluxnet are senior forest management practices specialist Han Chen and project forester Stan Vasiliauskas, who are based at the South Porcupine office. They helped with site selection in northeastern Ontario and are acting as liaisons between Fluxnet researchers and the local OMNR office and forest industry.

Funding for Fluxnet-Canada ($7.9 million over three years) is being provided by the Canadian Foundation for Climate and Atmospheric Sciences (CFCAS), the Natural Sciences and Engineering Research Council (NSERC), the BIOCAP Canada Foundation, Environment Canada, and Natural Resources Canada. The work of Fluxnet-Canada's researchers will be linked to similar work in the United States (AmeriFlux) and Europe (CarboEuroFlux).

For more information on soil carbon research in Ontario, contact Jim McLaughlin at ext. 418, jim.mclaughlin@mnr.gov.on.ca. For more on modelling Ontario's carbon budget, contact Changhui Peng (605-394-1996, changhui.peng@sdsmt.edu) or request OFRI Forest Research Report No. 158 (Quantifying Ontario's forest carbon budget. 1. Carbon stocks and fluxes of forest ecosystems in 1990). *For more on Fluxnet-Canada, visit http://www.cfcas.org/fluxnetreleasee.htm.*

Tree improvement and forest genetics workshop a success

By Lisa J. Buse

If you were going to start a tree improvement program, would you choose a traditional seedling orchard or a clonal seed orchard approach? Although a clonal orchard is usually more expensive, it may provide the greatest gains in growth, tree form, and fibre quality, as well as maintain higher levels of genetic diversity in subsequent generations, according to a case study in New Brunswick.

This finding was one of many presented at a June 2002 tree improvement and forest genetics information session and short course hosted by OFRI's forest genetics research group in Sault Ste. Marie. The one-day information session brought together tree improvement (TI) experts to present current programs and techniques being used in Ontario, New Brunswick, and the southern United States. The short course provided more detail about implementing TI programs and breeding strategies.

Forest Research Information Paper No 151

Forest Genetics and Tree Improvement in Ontario:

Synopsis of a Science Workshop

Ontario

Based on the presentations, a major challenge facing TI programs is balancing selection for increased growth or other traits with conserving genetic diversity. Another issue is the economic viability of tree improvement. Success in realizing gains depends partly on the amount of genetic variation in both the trait and the species of interest. For example, programs for species with little genetic variation in height growth, such as red pine, will have lower gains than programs for species with more variation in growth, such as spruce. Success also depends on how fast seed becomes available at each stage of improvement (species that produce cones at younger ages will produce gains more rapidly) and how much improved stock is planted.

According to Marilyn Cherry, forest genetics data analyst at OFRI and workshop coorganizer, the sessions were a great opportunity for forest industry staff to discuss the context in which Ontario's TI programs have evolved, to learn about TI approaches outside Ontario, and to consider how they might advance or build flexibility into their own programs by incorporating some of the ideas presented. Ontario is now moving from first-generation TI programs that focus on gains in height growth to second-generation programs that may include selecting for additional traits, including wood quality and disease resistance.

"One of the key messages emphasized at the workshop was to focus on the best material and manage it intensively," Cherry says. "Some of the developing issues include how to determine the cost/benefits of TI over a full rotation, how to balance genetic gains with maintaining genetic diversity, and how to implement tree improvement programs for hardwoods."

Forest industry staff who are now implementing tree improvement in Ontario are quick to point out the need for more knowledge transfer, training, and decision support aids.

Pengxin Lu, a forest genetics research scientist at OFRI and workshop coorganizer who is relatively new to OMNR, appreciated the opportunity to meet those involved in tree improvement in the province and the overview of new technologies presented by invited speakers Tim White, a University of Florida professor, and Greg Adams, silviculture manager with J.D. Irving in New Brunswick. Lu will be pursuing research to address some of the challenges facing Ontario's TI programs, including:

- How genetic variation affects growth potential, adaptation, disease resistance, and wood quality of major forest species
- Whether or not we can regenerate jack pine, black spruce, and white pine using clones of selected individuals
- How important genotype-by-environment interactions are and their effects on breeding zones in Ontario
- Whether early selection is effective in Ontario's TI programs

A workshop summary is available that provides an overview of information presented, including tree improvement principles and techniques, new technologies, and recommendations for future changes in Ontario's tree improvement programs.

To order a copy of Forest genetics and tree improvement in Ontario: Synopsis of a science workshop *(OFRI Forest Research Information Paper No. 151), call the OFRI publication request line at ext. 271 or e-mail information.ofri@mnr.gov.on.ca. For more information about forest genetics research in Ontario, contact Pengxin Lu (ext. 415), Marilyn Cherry (ext. 407), or Bob Sinclair (ext. 431) at OFRI (e-mail addresses: firstname.lastname@mnr.gov.on.ca)*

Symposium, report present latest on emulating natural disturbances

By Lisa J. Buse

What do we know about emulating natural forest disturbances (ENFD) at the landscape scale? That was the subject of an international science symposium held in Sault Ste. Marie in May 2002, the purpose of which was to provide researchers, policymakers, and resource managers with an opportunity to discuss the scientific foundation of this evolving management approach. Discussions covered possible definitions for emulating natural forest landscape disturbances and associated expectations, methods, and potential applications.

Based on both the presentations and attendance at the 2-day symposium, which drew 200 people from as far away as Switzerland and the Czech Republic, it was apparent that widespread interest in this topic exists not only across North America but also in Europe. Presentations indicated that not only do we know quite a lot about disturbance patterns, especially in boreal forests, we also have the knowledge and the technology to model, explore, evaluate, and compare management scenarios.

However, to implement ENFD successfully on the ground, some common expectations of the outcomes are needed. A major challenge is agreeing to a common definition of ENFD: What is *natural*? Is emulating copying *all* or just aspects of processes or outcomes? At what scale? Over what timeframe? And which types of disturbances?

Attendees at the symposium included representatives of forest industry, non-government organizations, and provincial/state and federal governments from both Canada and the United States.

Photo by Eva Pinnau, Wilderness Outfitters

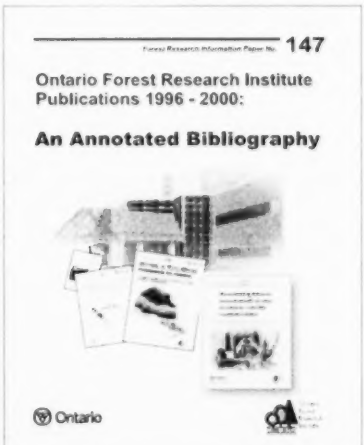
Symposium post-conference tour participants from Canada, the United States and Switzerland at Wilderness Outfitters near Chapleau, ON in May 2002.

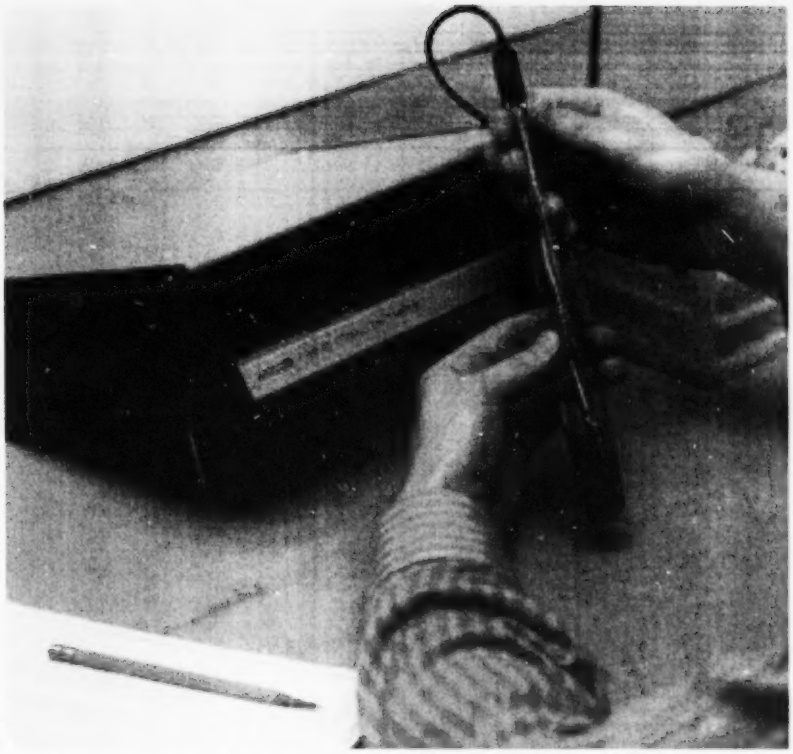
Summaries of presentations are available in an OFRI report titled Emulating natural forest landscape disturbances: Concepts and applications popular summaries *(OFRI Forest Research Information Paper No. 149). To order a copy, call the OFRI publication request line at ext. 271 or e-mail information.ofri@mnr.gov.on.ca.*

New OFRI bibliography summarizes 5 years of forest research in Ontario

OFRI has published an annotated bibliography that includes nearly 500 publications that were written, coauthored, or commissioned by OFRI staff between 1996 and 2000. Types of publications included in this bibliography: journal articles, research reports, information papers, technical notes, newsletter articles, papers in conference proceedings, and brochures. Many of these publications report on results of projects funded under Ontario's Sustainable Forestry Initiative.

To obtain a copy of this bibliography, titled Ontario Forest Research Institute publications 1996-2000: An annotated bibliography *(OFRI Forest Research Information Paper No. 147), call the OFRI request line (ext. 271) or e-mail information.ofri@mnr.gov.on.ca.*





MNR Photo

Ontario's frost hardiness testing process, which was operationalized through the efforts of OFRI researcher Steve Colombo, involves freezing seedling shoot tips, putting them in water in a test tube, and after a period of time, determining the electrical conductivity of the water. When seedlings experience freezing beyond their tolerance level, cell membranes get damaged, allowing electrolytes to leak out. Electrolytes conduct electricity when dissolved in water; thus, the higher the electrical conductivity of the water in the tube, the more damaged the seedling is.

Saving seedlings from "frostbite"

By Abigail M. Obenchain

Foresters, nursery managers, and anyone else interested in ensuring forest regeneration success should check out *Frost Hardiness Testing: An Ontario Update* (Forest Research Note No. 62), published recently by OFRI. This note provides an overview and update on frost hardiness testing, which is used to determine whether seedlings are ready to be stored for the winter.

According to OFRI research scientist Steve Colombo, who helped develop this testing in the early 1980s, seedling growers used to lose large numbers of nursery-grown conifer seedlings that were stored outside over the winter. The culprit: frost damage. Seedlings were often still growing when they were placed outdoors, and exposure to freezing temperatures damaged or killed the trees. Unfortunately, you cannot tell just by looking whether seedlings are frost hardy or not.

Since the advent of frost hardiness testing in Ontario, growers and foresters have had the means to ensure that seedlings are ready for overwintering (either outdoors or in freezers), thus preventing the death of millions of Ontario seedlings and improving forest regeneration success. In Ontario, this testing is now conducted by KBM Forestry Consultants in Thunder Bay. Testing facilities in Manitoba and the Maritimes are using these methods as well.

For more information on frost hardiness testing, contact Steve Colombo (ext. 409, steve.colombo@mnr.gov.on.ca). If you'd like a copy of OFRI Forest Research Note No. 62, call the OFRI request line (ext. 271) or e-mail information.ofri@mnr.gov.on.ca.

Want to be the first to hear about new OFRI projects, results, and publications?

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... to the *Insights* newsletter editor at abigail.obenchain@mnr.gov.on.ca. People on this e-mailing list will be the first to hear the latest developments in OFRI's forest research.

Many thanks for your interest in OFRI's research and publications!

Coming next issue...

- White pine blister rust study looks at genetic resistance
- Predicting boreal forest fire regimes
- New tolerant hardwood research database/bibliography
- Overview of ice damage research results

OFRI staff news

- The leave of **Changhui Peng**, an OFRI modelling research scientist, has been extended until August 2003. He is working as an associate professor specializing in climate change modelling at the South Dakota School of Mines and Technology in Rapid City.
- Forest ecology/silviculture research scientist **R.A. Lautenschlager** left OFRI in April to become executive director of the Atlantic Canada Conservation Data Centre in Sackville, NB.
- **David DeYoe** has returned to his home position as manager of the Forest Research and Development Section at OFRI after a year-long stint as manager of knowledge exchange and technology exploitation services with the Sustainable Forest Management Network.
- **Terry Taylor**, an OFRI science management coordinator who filled in for **David** during his time away, has taken on a new challenge as manager of the OMNR district office in Wawa.
- After a temporary assignment with OMNR's Forest Fire Management Section, **Vivienne Scott** has returned to her home position as a science management coordinator at OFRI.
- **Tim Meyer** resigned his position as science management coordinator at OFRI to become president of Sault College.
- **Mark Parsons** has replaced **Tim**; previously, **Mark** held a temporary science management coordinator position at OFRI.
- OFRI chemical technologist **Nick Seymour** passed away September 11, 2002. He was 47.

Upcoming events

May 1-2, 2003: ***9th National Forest Congress,*** Ottawa, ON. Sponsors: Canadian Forestry Association, National Forest Strategy Coalition, Canadian Council of Forest Ministers. Contact: congress@forest.ca, http://nfc.forest.ca.

May 6-10, 2003: ***Central Canada Boreal Forest Summit and Expo 2003: Highlighting the Economic Drivers of the Boreal Forest,*** Timmins, ON. Contact: Canadian Trade-Ex, (866)754-9334, http://www.woodtech.net.

June 9-11, 2003: ***2nd Annual Sustainable Forest Management Summit: Meeting Emerging Ecological, Economic, and Social Challenges,*** Sault Ste. Marie, ON. Sponsor: Great Lakes Forest Alliance. Contact: Wendy Hinrichs Sanders, Executive Director, Great Lakes Forest Alliance, Inc., (715)634-2006, forestls@lsfa.org, http://www.lsfa.org.

July 20-24, 2003: ***10th North American Forest Soils Conference: Forest Soils Research - Theory, Reality and Its Role in Technology Transfer,*** Sault Ste. Marie, ON. Sponsors: Soil Science Society of America, Society of American Foresters, Canadian Institute of Forestry, Canadian Society of Soil Science, USDA Forest Service. Contact: Mary Beth Adams, USDA Forest Service, Parsons, WV, mbadams@fs.fed.us, http://www.fs.fed.us/forestsoilsconference/.

September 21-28, 2003: ***XII World Forestry Congress - Forests, Source of Life,*** Quebec City, QC. Contact: (418)694-2424, sec-gen@wfc2003.org, http://www.wfc2003.org.

September 21-28, 2003: ***2003 CIF/IFC Annual General Meeting and Conference,*** Quebec City, QC (meeting will be held during the World Forestry Congress). Contact: (613)234-2242, cif@cif-ifc.org, http://www.cif-ifc.org/agmpage.html.

Have a suggestion?

Want more information a research project?

We want to hear from you!

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